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The Genus Ceanothus L. in Iowa

B. Shimek
State University of Iowa

THE GENUS *CEANOTHUS* L. IN IOWA

B. SHIMEK

The low shrubs known as New Jersey Tea, belonging to the Genus *Ceanothus,* were once very abundant throughout Iowa, occurring chiefly on the prairies, and sometimes in dry, open woods and along the borders of drier thickets. On account of their long, tough roots they interfered with the breaking of the prairie, and the commoner species, *C. americanus,* known as "shoestring" or "red-root," was by no means popular with the pioneers. Perhaps for this reason, and because they were so common, these attractive shrubs were seldom cultivated in this state.

In more recent years, however, as the native plants became rarer, their cultivation has increased, especially eastward. Their conspicuous dense clusters of small white flowers and their not unattractive foliage, together with their hardiness, make them very desirable for this purpose. As the forms in our state are very variable, and also differ somewhat in habit and distribution, a discussion of them should interest both the amateur lover and the scientific student of plants.

The Genus *Ceanothus,* as now recognized, is wholly American. Related species from other parts of the world are now placed in other genera. In 1753 Linné [41]* recognized but three species, of which only one, our *C. americanus,* is now retained in the genus. The same species were listed by Aiton[1] in 1789, but in 1811 he[2] increased the number to five, of which three are now placed in other genera. In 1825 DeCandolle[20] recognized forty-one species, but he included a dozen species now placed elsewhere. In 1867 Bentham and Hooker[9] placed the number of species at about twenty-eight; Parry[53] listed thirty-three North American species in 1889; in 1896 Engler and Prantl [23] credited North America with thirty-six species; while in 1905 Britton[11] placed the number at about thirty-five for North America. Up to 1913 the Kew Index and Supplements[37] enumerated sixty-eight species, which probably are not all valid.

The great majority of the species are found in the dry sections

* The superior figures throughout refer to the numbers in the Bibliography at the close of this paper.

of the western part of our country and northern Mexico. In Iowa two species and a variety have been recognized. Like all other members of the genus these forms are very variable, and in consequence there is much confusion in the descriptions, and in the definition and recognition of species. A discussion of these differences and variations, so far as they concern the Iowa species, is here presented.

The three forms found in Iowa are: *Ceanothus americanus* L., *C. ovatus* Desf., and *C. ovatus pubescens* T. & G.

I. *Ceanothus americanus* L. Pl. VIII, fig. 1, a to i; l to p.

This is the larger species, once common on the prairies, especially in the eastern part of the state, but now most commonly preserved in dry, open woods and oak openings. This species is variable both in form and structure of some of its parts and in habit, but it may usually be readily recognized by its broad, soft, often subcordate leaves, the elongated stalk of the flower cluster, the usually clustered stems, and the larger, lighter-colored smooth seeds. The flower cluster is also usually more elongated than in the following species, and the flowers appear later.

A comparison of published descriptions and observations on our Iowa material shows that practically the entire range of variation in this species is exhibited in the Iowa representatives. The leaf is the most variable part of the plant and a more detailed discussion of its characters is worth while.

Form. — The form of the leaf is variously described in the books as ovate [4 21 22 25 26]; ovate or oblong-ovate [13 15 31 40 71 72 74 76]; oblong-ovate [18 19 77]; obovate or oblong-ovate [32]; heart-ovated [10]; and ovate or ovate-lanceolate, rarely orbicular ovate [68].

The most common Iowa forms vary from oblong, through oblong-ovate to ovate, but the larger leaves on most plants are often cordate-ovate or even cordate. Occasionally the leaves, especially the later ones, are narrowly oblong or ovate-lanceolate, and still less frequently broadly oval or nearly orbicular leaves occur.

Base. — The base of the leaf has been described as rounded or rarely acutish, or sometimes a little cordate [72]; abruptly narrowed or subcordate [68]; sometimes unequal or slightly cordate [18 71]; obtuse or subcordate [11 13]; often slightly heart-shaped [31 32]; and acute or sometimes slightly cordate [71].

The Iowa specimens show much variation in the form of the base, often on the same plant. They are rather rarely narrowly acute at base, but more frequently vary from broadly or abruptly

acute through obtuse or rounded, to subcordate, or rarely quite cordate.

Apex. — The apex of the leaf is by no means uniform. It has been described as usually acute [4]; acute or acutish or rarely acuminate [68]; acute or acuminate [11 13 32]; acuminate [10 18 19 21 22 26 71 72]; and acute or slightly acuminate or obtusish [72].

Iowa specimens vary from short-acuminate through sub-acuminate to acute, somewhat obtuse, distinctly obtuse or rounded. Few distinctly acuminate forms occur. The apex is often very variable in the leaves of the same plant. The same thing, however, is also true of the other leaf characters.

Margin. — The margin of the leaf is represented as serrate [11 13 18 21 26 32 40 71 72 74 76]; finely serrate [10 30]; finely and irregularly serrate [4]; and toothed [68].

Most of the Iowa leaves are sharply, often finely serrate near the base, and serrate-dentate, serrate-crenate, crenate-dentate, or dentate towards the apex. Sometimes the teeth are quite irregular, and in all cases at least the younger leaves have the teeth black-tipped.

Surface. — The surface of the leaf is exceedingly variable. It has been described as more or less villous pubescent [74]; very downy with soft hairs beneath [77 78]; finely pubescent, especially beneath [12]; more or less pubescent [31 32]; downy beneath [30]; somewhat pubescent [26]; pubescent beneath [19 21]; pubescent — tending to become glabrous with age [68]; nearly glabrous above, canescently tomentose beneath [72]; nearly smooth above, more or less velvety pubescent underneath [71]; pubescent beneath; upper nearly smooth; nerves quite hairy beneath, more or less ferruginous [18]; bright green and dull above, paler and pubescent or nearly glabrous beneath [4].

The Iowa specimens exhibit equal variation. Some are densely pubescent on the lower surface, with short scattered loose or appressed hairs above; others have the lower surface densely pubescent while the upper is quite glabrous; still others are pubescent below, and on veins, only, above; and still others are glabrous above and pubescent only on the veins below. The young leaves are usually quite densely pubescent, but they often become nearly or quite glabrous above as they mature.

Size. — The size of the leaf is also very variable, commonly on the same plant. The length of the blade is variously recorded as 1 to 3 inches [13]; 1½ to 3 inches [4]; 1½ to 2½ inches [74]; 2 to 3

inches [10 71 72]; 2 to 4 inches [18]; 2.5 to 7.5 cm.[11]; 3.5 to 6.5 cm.[15]; 3 to 10 cm.[68]. The width is given as follows: ½ to 1 inch [13]; 1 inch [10]; 1 to 2 inches [18]; 1.25 to 2.5 cm.[11]; 2.4 to 5.5 cm.[32].

Several hundred Iowa specimens were examined. They show a maximum length of 12.1 cm., and a maximum width of 6.4 cm. The leaves on our plants vary much in size, those on the upper parts of the stem and branches being quite small, often falling much below the minimum in the published descriptions.

The petiole. — The length of the petiole is variously given as from ⅛ to ½ an inch, or 4 to 12 mm. In the Iowa specimens the length varies from 2 to 13 mm., the usual length being about 4 to 6 mm.

Habitat. — This species is assigned to a great variety of habitats in the published descriptions. It is credited to woods [25]; woods and groves [77 78]; woods, sunny places [29]; woodlands and thickets [19]; growing in shade [3]; low pine woods [38]; sandy woods [6 7]; open woods [24 27]; dry woodlands [31]; dry woods [4 44 76]; dry open woods [11 13]; dry woods and copses [71]; copses [34]; dry woodlands and gravelly slopes[32]; dry open woodlands and along river banks[48]; dry open woods and fields in sterile soil[14]; dry woods and on hillsides[68]; barrens [77 78]; meadows and thickets [54]; upland woods and prairies [26]; dry woodlands and prairies [5]; prairies and open woods [35]; prairies and forest-border [63]; prairies and edge of woods [47 48 63 66]; half-wooded prairie hills and even on prairie, but more frequently at the thicket edge near the bur-oak clumps [42]; dry grounds [29]; dry hills [68]; higher slopes and drier places [61]; on hills [57]; loess hills [50 65]; dry gravelly hills [45 66]; in dry places, along roadsides, on prairies, etc.[62]; prairie openings [64]; prairies [28 34 49 51 52 66 75]; dry prairie [16]; highland prairie [70]; dry prairies and ridges [33 63]; sand and prairie[67]; sand and gravel [64]; sandy shores and dunes [66 67]; and simply as xerophilous [46].

While frequently reported from woods even in Iowa, this species was here primarily a prairie plant. The general cultivation of the prairie has destroyed much of its former habitat, and it is now found only on the scattered remnants of the unbroken prairie, in open places in upland woods, and in a few places on sand and gravel. It does not occur in deep woods, but is sometimes found in places which are quite well shaded during at least a part of the day. In such places it grows taller, more spindly, with weaker stems, looser flower clusters, and larger and thinner leaves. The specimens with the finest, most compact and abundant

flower clusters, are found quite in the open here in Iowa. The species is essentially xerophytic, though somewhat less prominently so than the variety of the following species.

The flowers are usually at their best during the last week of June and the first week of July, but occasional specimens may be found in flower in the southern half of the state as early as the first week in June, and in the northern part as late as the second week of August.

This species is distributed throughout the state, and no doubt originally occurred in every county of the state. It is (and was) more common, however, in the eastern half of the state, and here now more frequently occurs in open woods. In the western part of the state it is largely displaced by the variety of the following species, particularly on drier knolls, etc.

New Jersey Tea is worthy of cultivation, and should be grown in rather light soil, in well-drained and preferably open places, though it will stand some shade. It may be propagated from seeds or cuttings. The great extent of the roots, especially if growing in open places, makes it difficult to transplant larger plants.

2. *Ceanothus ovatus* Desf. Pl. VIII, fig. 1, j, k.

This species and its variety may be distinguished from the preceding species by the following characters: the stems are usually single, not clustered; the leaves are smaller, narrower, never cordate at base, and thicker; the flower clusters are usually shorter and on shorter stalks; and the seeds are usually dark brown, distinctly marked with shallow, irregular pits, and their length does not exceed 2 mm. The seeds of *C. americanus* are more than 2 mm. long, light brown in color, and usually shiny and without pits. Only a few seeds of the latter have been observed with pits, and these appeared in most of them on only a part of the surface. These seeds were obtained from the most vigorous plants of the species which the writer has seen in Iowa, and were collected in upland woods, rather open, near McGregor. These seeds were 3 mm. in length. Immature seeds of both species are likely to be grayish, or grayish-brown.

The typical form of *C. ovatus* is quite rare in Iowa. It has been reported from several counties of the state, but in the majority of cases the plants belong to the following form, which has been recognized as a variety. The writer's own observations in all parts of the state convince him that the type is not common

in Iowa, and that the variety is by far the more common representative of the species, especially in the western part of the state. The variety does not occur in the eastern part of our country so far as references at hand indicate. To avoid confusion with the variety, eastern authors are chiefly cited in the following discussion of the type form.

This species also represents a wide range of variation, especially in the character of the leaf, as is shown in the following summary of references and characters.

Form. — Eastern and southeastern authors describe the leaves as narrowly oblong to elliptic, oval or ovate [68]; oblong to oval or ovate [59]; oval, elliptical, sometimes oblong [10]; oval [21]; narrow-oval, or lance-oblong [30]; narrowly oval or elliptical lanceolate [74]; elliptic to elliptic-lanceolate [4]; oblong or oval-lanceolate [13]; oval-lanceolate [77]; oval-lanceolate or narrowly oblong [78]; narrowly oblong or elliptical lanceolate [71 72]; narrowly oval or elliptical lanceolate [31 32 40]; oval to linear-oblong [71]; oval to almost linear, never ovate [71 72].

Iowa specimens, collected near Winterset and New Albin, have leaves varying from oblong to oblong-ovate, lance-ovate, and lanceolate, thus practically covering the entire range of variation in form as presented in the published descriptions.

Base. — The base is variously described as acute [71]; mostly acute [77 78]; acute or rounded [66]; and mainly obtuse [11 13].

The Iowa specimens noted above vary from acute to broadly acute and sub-obtuse.

Apex. — The apex of the leaf is defined as acute, sometimes obtuse [71 72]; mostly acute [77 78]; mainly obtuse, sometimes acute [11 13]; obtuse or sub-acute [10]; obtuse or acutish [68]; and obtuse or rounded [32].

The apex of the Iowa specimens varies from acute to sub-acute, narrowly obtuse, and obtuse.

Margin. — The margin of the leaf is described as serrate [10 11 12 13 21 68]; finely glandular serrate [31 32 40]; serrulate [71 72]; crenately serrate [10 77 78]; and crenulate-serrate. All agree that the teeth are gland-tipped, and several define them as black [10 71 77 78].

The Iowa specimens are serrate towards the base and crenulate-serrate, or crenate-serrate, towards the apex.

Surface. — As the distinction between the species and variety is based wholly on the character of the surface, especially of the leaves, the following published descriptions of the surface of the leaf are of especial interest. It is described as smooth, never

pubescent beneath [21 22]; nearly glabrous, glossy above [4]; nearly glabrous [11 72]; glabrous to nearly so [31 32]; nearly smooth [8]; lower surface glabrous or with few scattered hairs, nearly glabrous [68]; nearly glabrous or somewhat pubescent [74]; veins pubescent beneath; smooth and shining [76 77 78]; veins slightly pubescent underneath; sometimes lower surface covered with glands [10]; pubescent when young; at length nearly or quite smooth, except the slight pubescence on veins underneath [71]; glabrous, or with few hairs on principal veins; nearly glabrous throughout, or W. races densely pubescent [12 13]. The last-mentioned western races are the variety *pubescens*!

In the Iowa specimens the upper surface of the leaf is glabrous, or very nearly so, occasionally with a few inconspicuous short scattered hairs. The lower surface is sometimes slightly pubescent, the pubescence being almost wholly on the veins, and quite inconspicuous. Very young leaves are more or less brown-pubescent but the upper surface soon becomes green and more or less shiny.

Size. — The size of the leaf as given in the various descriptions varies from 1 to 3 inches (1.5 to 7.5 cm.) in length, and from ¼ to¾ of an inch (6 to 18 mm.) in width.

The Iowa leaves vary from 3.0 to 7.2 cm. in length, and from 1.2 to 3.4 cm. in width.

The great variation in characters has resulted in efforts to recognize varieties, and several have been named but they are of little interest here in Iowa, as they are mostly southern or eastern, or of little significance.

Habitat. — Western references to habitat probably apply in large part to the variety. In the references which manifestly apply to the typical form the habitat is given as follows: Rocks [30]; dry rocks [31]; dry rocks or sandy soil [32]; barren rocky places [71 72]; on dry gravelly banks [45]; sandy shores [55]; sandy soil [68]; rocky places and on prairies [12 13]; knolls in the rolling prairie [39]; and shade [3].

The most typical Iowa forms were found in open places on rocky slopes — rarely on the prairie. The typical form resembles the variety when the leaves and shoots are quite young, but at maturity the shiny green, glabrous, or nearly glabrous, upper surfaces of the leaves, and the scant pubescence elsewhere, give the plant a strikingly different aspect.

This species may be cultivated in much the same manner as the preceding form. It is not easily obtained in Iowa, however, and the other forms are quite as suitable.

3. *Ceanothus ovatus pubescens* T. & G. Pl. VIII, fig. 2, a-o.

The standing of the form with the persistent pubescence on the leaves, peduncles and twigs has been more or less in dispute. Long ago Torrey and Gray [72] recognized a variety to which later the name *pubescence* was given. The leaves, especially on the veins, the young branches, and the peduncles, are pubescent, and the leaves are usually smaller and the pubescence ferruginous. This describes very well the commoner form in Iowa. More recently this form has been assigned the rank of a species by several authors [17 58 59 68]. On the other hand, other authors do not even recognize the variety, but consider all the forms under the specific name *ovatus* [13].

Surface. — The flowers and flower clusters, the seeds, and the form, base, apex, margin, venation and petiole of the leaf of this form agree with the type, presenting the same variations and offering no mark of distinction. None of the authors consulted, who describe both the species and the variety, make mention of these characters, but they place the emphasis on the surface of the leaves, and sometimes on the peduncles and twigs. The published references to this character show some differences, but all agree that more or less pubescence persists on both surfaces of the leaf, that on the lower being more copious. The various authors describe the surface of the leaf as pubescent [72]; densely pubescent [11 12 13]; copiously and permanently pubescent beneath [68]; permanently sordid-tomentose [82]; glabrate except the veins above; villous beneath [60].

Iowa specimens show considerable variation in the amount of pubescence, but the great majority are readily referable to this variety, for even the fully matured leaves retain much of the pubescence. Speciments from Lyon, Harrison, and Shelby counties have leaves densely pubescent on both surfaces, but in the great majority of cases the lower surface is quite densely pubescent (the pubescence being chiefly on the veins), while the upper surface is provided with straighter hairs, which may be scant and scattered, or quite crowded. The twigs and peduncles in all cases retain much of the dense pubescence until late in the season. The pubescence is usually brownish or rusty, but sometimes almost white.

Form. — In form the leaves of Iowa specimens are usually oblong or oblong-ovate, but they vary from broadly oblong, to oblong-ovate, obovate, oblanceolate, oblong-lanceolate, linear-lanceolate, and linear-oblong.

Base. — The leaf base is also somewhat variable, though it is usually acute or sub-acute. It varies, however, to obtuse and rounded, but is never cordate.

Apex. — The apex is most frequently somewhat acute, or sub-acute, but varies from short-acuminate to obtuse or rounded.

Margin. — The margin is usually somewhat irregularly toothed, usually being serrate nearer the base and dentate or crenate towards the tip. It varies, however, from serrulate or crenulate to serrate, dentate, crenate, serrate-dentate, or crenate-dentate.

Size. — The blade of the leaf reaches a maximum length of 9.2 cm., but is usually 4 or 5 cm. long. The width reaches 4.9 cm., but more commonly it is about 2 cm. The petiole is usually about 1 cm. long, but varies from .2 cm. to more than 2.0 cm.

Habitat. — The habitat of the variety has been described as follows: sand-hills [57] [58]; sandy soil [59]; stony hillsides [49]; gravelly slopes [65]; dry hills [35]; loess ridges [65]; hillsides and in dry soil [68]; dry prairie ridges [33] [63]; dry prairie [63]; prairie [57] [65]; prairie and forest border [63]; open thickets [17]; wooded bluffs [57].

In Iowa the variety is found most commonly on dry prairie knolls or ridges, but also occurs in prairie openings on partly wooded hillsides.

The writer has collected this form in all parts of the state excepting the southeast quarter, but it is much more common in the western part of the state. Eastward in the state it is extremely local.

Both the type and variety usually flower in Iowa in the third or fourth week of May, though a few plants have been found in flower as late as the middle, and in one case even the end, of August. In any locality where both *C. americanus* and *C. ovatus* or the variety occur, the former will flower from three to four weeks later. Because of this circumstance, if for no other reason, the two species probably seldom, if ever, hybridize.

While there may be some doubt as to the validity of this form as a species or variety, it is ordinarily quite distinct, and the peculiarity of distribution makes it desirable to retain the name for ecological records. It is certain that the vast majority of Iowa plants belong to the variety rather than the type.

The writer had the privilege of examining the extensive set of *Ceanothus* in the collections of the Missouri Botanical Garden, St. Louis, and he found that all the eastern and southeastern forms of this species belong to the type, while the western and southwestern forms belong to the variety *pubescens.*

This variety is drought-resisting, and may be planted to advantage in dry places. It should be propagated like *C. americanus,* but it should be planted in open places.

The Iowa material herein discussed is deposited in the herbarium of the State University of Iowa.

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EXPLANATION OF PLATE VIII

Fig. 1 — *Ceanothus americanus* L. a to i and l to p.

a. to b. Seven leaves from same plant; open woods; West Lake Okoboji.
c. A leaf from plant on dry hill-top; McGregor.
d. A leaf from sandy prairie; Muscatine county.
e. Two leaves; open hillsides; New Albin.
f. to g. Three leaves; open hillsides; McGregor.
h. to i. Five leaves; prairie; Mapleton.
l. to m. Four leaves; prairie opening; Decorah.
n. Three leaves; open prairie; Roland.
o. A leaf; prairie opening; Allamakee county.
p. A leaf; open prairie; Nora Junction.

Ceanothus ovatus Desf. j, k.

j. Three leaves; open hillsides; New Albin.
k. Three leaves; prairie opening; Unionville.

Fig. 2. — *Ceanothus ovatus pubescens* T. & G.

a. to b. Eleven leaves from same plant; dry prairie hill; Decorah.
c. Two leaves; prairie; Harlan.
d. A leaf from loess prairie; Missouri Valley.
e. to f. Nine leaves from same plant; prairie; near W. Lake Okoboji.
g. A leaf from high dry prairie; Missouri Valley.
h. Two leaves; high dry prairie; Shelby county.
i. A leaf from open hillside; Decatur county.
j. Three leaves, from high loess prairie; Shelby county.
k. A leaf from rolling prairie; Logan.
l. A leaf from very dry loess prairie; Missouri Valley.
m. Two leaves, from rolling prairie; Shelby county.
n. A leaf, from very high, dry prairie; Harrison county.
o. A leaf from prairie opening; near Winterset.

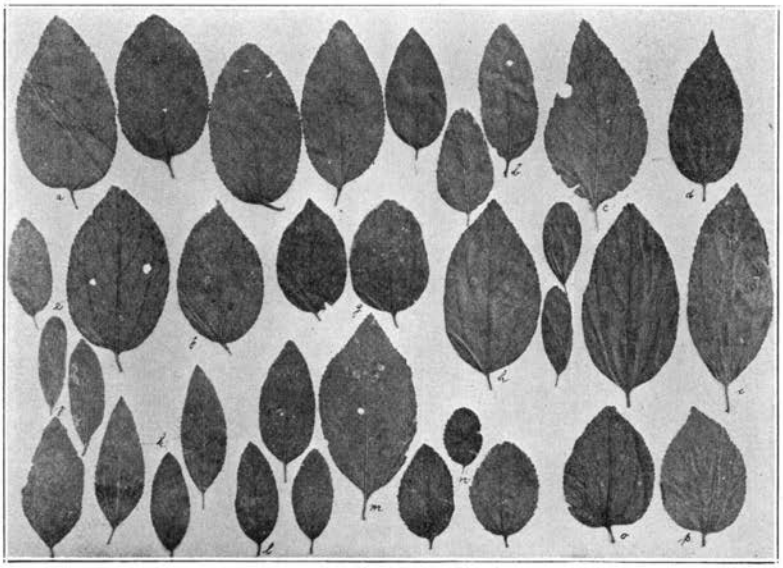


Fig. 1.

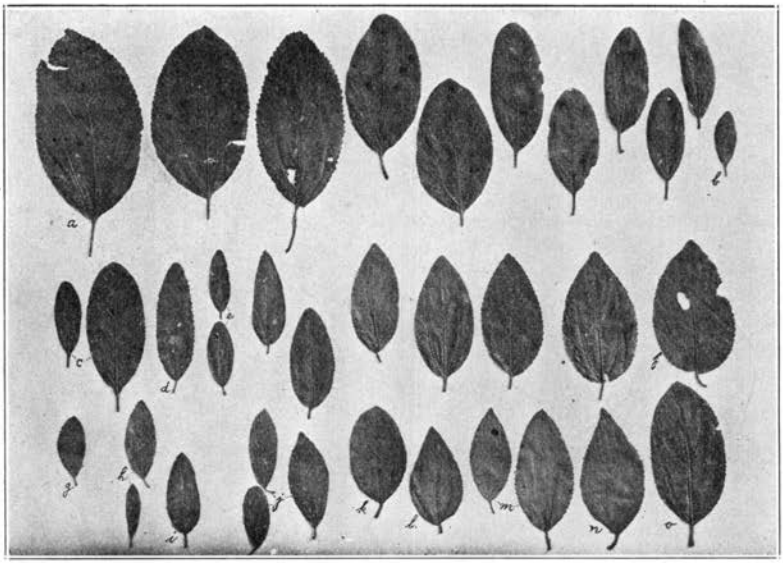
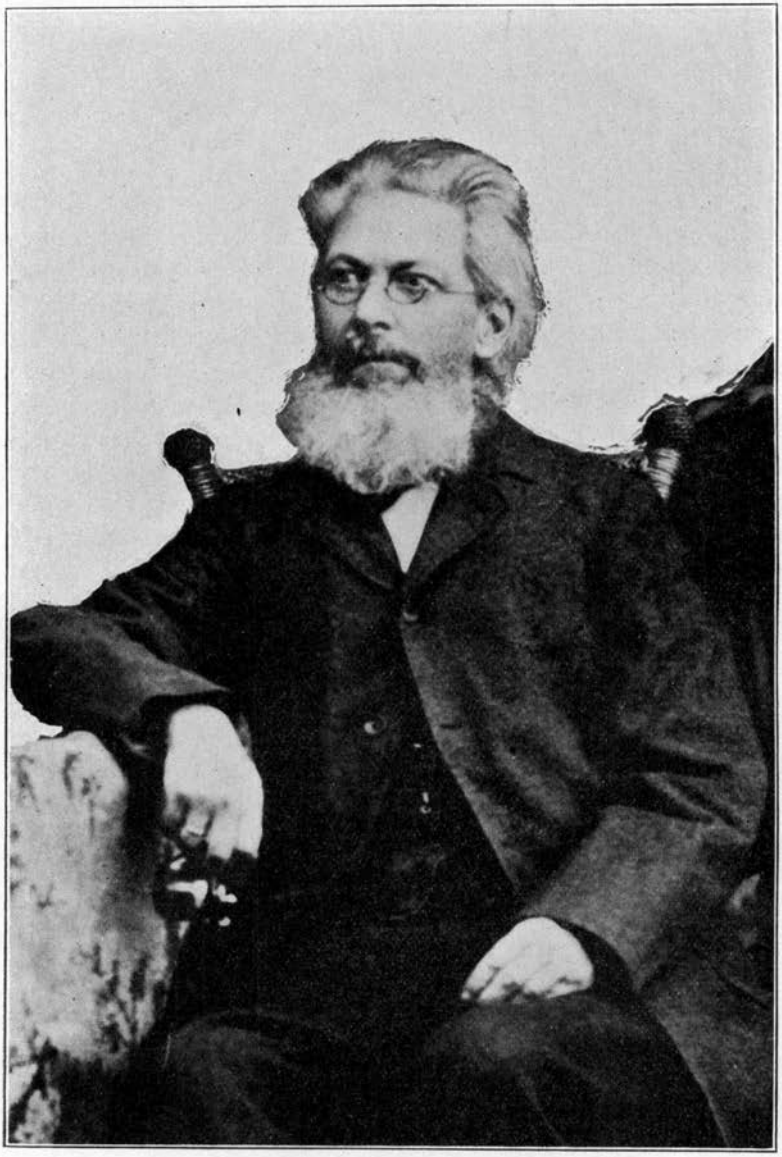


Fig. 2.



DR. RUDOLPH GMELIN

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